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or by-product, said process further comprising distilling the acrylic acid in the presence of a hydrazine compound aldehyde-treating agent to purify the acrylic acid, thus obtaining an acrylic acid having a protoanemonin content of not more than 10 ppm, and in that the resultant water-absorbent resin has a neutralization of not less than 50 mol%.

REMARKS

In the Action, claims 1-14 are rejected over the cited art. In response, claim 3 is cancelled, and claims 1, 8 and 12 are amended, and new claim 15 is added. Thus, the pending claims in this application are claims 1, 2 and 4-15, with claims 1, 8 and 15 being independent.

Claim 1 is amended to recite the step of subjecting 50 mol% or more of the acrylic acid or salt to the alkali treatment and then polymerizing the acrylic acid or salt. Claims 1 and 8 are also amended to recite the mixture of acrylic acid and/or its salt and the alkali is a solution containing 0.5 to 20 ppm oxygen. Support for these features is found on page 11, lines 4-11 of the specification.

Rejection of Claims 1-3, 5-7, 9 and 13

Claims 1-3, 5-7, 9 and 13 are rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 6,444,744 to Fujimaru et al. Fujimaru et al. is cited for disclosing a water-absorbent resin and a method of making the resin where the acrylic acid is distilled to remove the hydroquinone and benzoquinone. The Action contends that the distillation process of Fujimaru et al. inherently reduces the protoanemonin content of the acrylic acid. As amended, claim 1 is directed to a process of producing a water-absorbent resin comprising the steps of treating an acrylic acid or its salt with an alkali and where the mixture of acrylic acid and/or its salt and the alkali is a solution containing 0.5 to 20 ppm of oxygen. Claim 1 also recites treating at least 50 mol% of the acrylic acid or acrylic acid salt of the monomer component. Claim 1

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also recites the acrylic acid being produced by catalytic gas phase oxidation of propylene and/or propane where the raw acrylic acid contains impurities and by-products including protoanemonin as an impurity and further reducing the protoanemonin content to not more than 10 ppm. Fujimaru et al. does not disclose or suggest the combination of these claimed process steps.

Fujimaru et al. does not disclose a process of treating an aqueous solution containing a monomer component including acrylic acid or acrylic acid salt with an alkali and particularly a strong alkali where the solution contains 0.5 to 20 ppm oxygen. Fujimaru et al. further fails to disclose the process of treating at least 50 mol% of the acrylic acid or salt of the monomer component with an alkali under 0.5 to 20 ppm of oxygen. Fujimaru et al. further fails to disclose the step of reducing the protoanemonin content of the raw acrylic acid to not more than 10 ppm.

Fujimaru et al. discloses distilling acrylic acid to reduce the hydroquinone and benzoquinone content to an amount not greater than 0.20 ppm. The physical and chemical properties of hydroquinone and benzoquinone are different from the properties of protoanemonin. In particular, protoanemonin is an oily compound having a boiling point of about 45°C at 1.5 mm Hg. (The Merk Index, 12th Ed., No. 8078.) Hydroquinone is a solid having a melting point of 170-171°C and a boiling point of 285-287°C. (The Merk Index, 12th Ed., No. 4853.) Benzoquinone is a solid having a melting point of 115.7°C and readily sublimates. (The Merk Index, 12th Ed., No. 8259.) Accordingly, the purification requirements of Fujimaru et al. to remove the hydroquinone and benzoquinone are different from the requirements to remove protoanemonin of the claimed invention. Thus, the claimed invention is not obvious over Fujimaru et al. and Fujimaru et al. does not inherently reduce the protoanemonin content to the claimed levels.

As noted above, Fujimaru et al. does not disclose or suggest the process step of reducing the protoanemonin content of the acrylic acid. Claim 1 specifically recites the process of

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producing a water-absorbent resin by polymerizing a monomer component including acrylic acid and/or its salt and the step of reducing the protoanemonin content of the acrylic acid or salt to not more than 10 ppm prior to the polymerization. Therefore, Fujimaru et al. does not disclose the claimed process either expressly or inherently.

The present invention is directed to the discovery that the properties of the water-absorbent resin are improved where the resin is produced from an acrylic acid or salt that is treated to reduce the protoanemonin content to not more than 10 ppm. Claim 1 further recites the process where acrylic acid is treated with an alkali in the presence of oxygen and where the resulting solution contains 0.5 to 20 ppm of oxygen. The claimed process includes treating acrylic acid (substantially 100% acrylic acid) with an aqueous solution of an alkali, treating an aqueous solution of acrylic acid with an aqueous solution of an alkali, and treating an aqueous solution of acrylic acid with a solid or powder of an alkali. Thus, the resulting aqueous solution of the acrylic acid during and after the alkali treatment contains 0.5 to 20 ppm of oxygen. Fujimaru et al. discloses neutralizing the acrylic acid with a salt but does not disclose treating the acrylic acid or salt with an alkali and particularly a strong alkali under 0.5 to 20 ppm of oxygen. Furthermore, Fujimaru et al. provides no motivation or incentive to one skilled in the art to treat the acrylic acid or salt with an alkali to reduce the protoanemonin content as claimed.

Fujimaru et al. discloses a process for producing a water-absorbent resin where hydroquinone and benzoquinone are added as a polymerization inhibitor during the purification step. The hydroquinone is added to the process of Fujimaru et al. in small amounts so that it can be removed during the purification step. Fujimaru et al. is only concerned with removing the hydroquinone and benzoquinone prior to the polymerization step since these components are known to inhibit polymerization. As noted above, the properties of benzoquinone and hydroquinone are different from the claimed protoanemonin. Therefore, the process of Fujimaru et al. is selected to remove the benzoquinone and hydroquinone.

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Fujimaru et al. provides no suggestion that the protoanemonin content of the acrylic acid or salt monomer component have an effect on the properties of the resulting water-absorbent resin. Fujimaru et al. does not suggest distilling the acrylic acid or otherwise purifying the acrylic acid except when the hydroquinone or benzoquinone are added to the acrylic acid. Therefore, Fujimaru et al. does not disclose purifying an acrylic acid or salt monomer component where the monomer component does not contain added hydroquinone or benzoquinone. Therefore, Fujimaru et al. provides no suggestion of reducing the protoanemonin content of the acrylic acid or salt monomer component as claimed. As disclosed in the specification and the Examples and Comparative Examples in the specification, distillation does not necessarily reduce the protoanemonin content to the level recited in the claims. The Examples demonstrate that all distillation processes do not inherently reduce the protoanemonin content to the claimed range. Accordingly, Fujimaru et al. does not inherently reduce the protoanemonin content to an amount of not more than 10 ppm as claimed.

Fujimaru et al. also does not disclose or suggest the acrylic acid having a furfural content of not more than 10 ppm as recited in claim 2 in combination with the process steps of claim 1. Fujimaru et al. also fails to disclose the aqueous solution polymerization of claim 5, the crosslinking step of claim 6, or the resulting water-absorption capacity of claim 7 or the alkali treatment of the acrylic acid or salt at a temperature of not lower than 40°C as in claim 9, or the liquid permeation quantity of claim 13 in combination with the process steps of claim 1. Accordingly, these claims are not anticipated by Fujimaru et al.

Rejection of Claims 8, 10 and 14

Claims 8, 10 and 14 are rejected under 35 U.S.C. § 103(a) as being obvious over Fujimaru et al. in view of U.S. Patent No. 6,187,872 to Yanase et al. Yanase et al. is cited for disclosing a step of neutralizing the hydrogel with an alkali metal hydroxide.

Yanase et al. does not disclose or suggest treating an acrylic acid or salt monomer component with a strong alkali prior to polymerization as claimed. Furthermore, Yanase et al. does not disclose treating a monomer component containing acrylic acid or salt and reducing the protoanemonin content of the acrylic acid or salt before polymerization. Instead, Yanase et al. discloses only the alkali treatment of the resulting super absorbent agent after polymerization.

The passages of Yanase et al. referred to in the Action do not disclose purifying the raw acrylic acid or salt with an excess of an alkali metal hydroxide or with a strong alkali as claimed. The passages referred to in the Action in columns 8 and 9 of Yanase et al. refer to "post-neutralization" after the polymerization of the monomer. Column 9, lines 1-5 specifically disclose that the post-neutralization step is carried out after polymerizing the monomer component "which has not been neutralized or has been neutralized to a relatively low neutralization ratio". There is no suggestion in Yanase et al. that the alkali or alkali metal hydroxide of the claimed invention is an equivalent of the salts of Fujimaru et al. for treating a monomer component containing acrylic acid or salt thereof. Accordingly, claim 4 is not obvious over the combination of Fujimaru et al. and Yanase et al.

Claim 8 is amended to recite the process for producing a water-absorbent resin comprising treating acrylic acid and/or its salt with an alkali and where the mixture of the acrylic acid and/or its salt and the alkali is a solution containing 0.5 to 20 ppm oxygen and thereafter polymerizing the component containing acrylic acid and/or its salt. Claim 8 is further amended to recite the raw acrylic acid containing impurities and where the acrylic acid contains not less than 10 ppm of an aldehyde as an impurity or by-product. Fujimaru et al. and Yanase et al. do not disclose or suggest these process steps. In particular, Fujimaru et al. and Yanase et al. fail to disclose or suggest treating an acrylic acid or acrylic acid salt component with an alkali metal hydroxide in a solution containing 0.5 to 20 ppm oxygen. Accordingly, claim 8 is not obvious over Fujimaru et al. and Yanase et al.

Claim 14 depends from claim 8 to recite the step of purifying the acrylic acid to reduce the protoanemonin content to not more than 10 ppm followed by the strong alkali treatment. Fujimaru et al. does not disclose the step of purifying the acrylic acid or salt to reduce the protoanemonin content to not more than 10 ppm and then treating the acrylic acid or salt with a strong alkali. As noted above, Yanase et al. discloses neutralizing the resulting polymer, but does not disclose treating the acrylic acid or salt with an alkali metal hydroxide. Furthermore, Yanase et al. provides no motivation or incentive to treat the acrylic acid having the hydroquinone and benzoquinone content of Fujimaru et al. with an alkali metal hydroxide. Accordingly, claim 14 is not obvious over Fujimaru et al. in view of Yanase et al.

Rejection of Claims 11 and 12

Claims 11 and 12 are rejected under 35 U.S.C. § 103(a) as being obvious over Fujimaru et al. in view of U.S. Patent No. 3,725,208 to Maezawa et al. or Japanese Patent 9-316027 or British Patent GB 2,285,046. The secondary references are cited for disclosing the use of a hydrazine in a process for the distillation of acrylic acid to reduce the aldehyde content.


The secondary references disclose generally the use of a hydrazine compound. However, the secondary references provide no motivation or incentive to one of ordinary skill in the art to use a hydrazine compound or an aldehyde treating compound in a distillation of acrylic acid to reduce the protoanemonin content of the acrylic acid or acrylic acid salt component as claimed. The secondary references clearly do not recognize or appreciate that the addition of an aldehyde treating agent or hydrazine during the distillation would effectively reduce the anemonin content to within the claimed range. The secondary references further fail to suggest that the reduced anemonin content would improve the polymerization process. As noted in the Action, the secondary references disclose generally the use of a hydrazine compound to remove aldehyde impurities. In contrast, Fujimaru et al. discloses the purification process to remove the

hydroquinone or benzoquinone. Thus, the secondary references provide no motivation to one of ordinary skill in the art to add hydrazine or other aldehyde treating compound in the distillation process of Fujimaru et al. since the addition of the hydrazine would have no effect on the intended result of Fujimaru et al., namely, the removal of hydroquinone or benzoquinone. Accordingly, it is not obvious to one of ordinary skill in the art to modify the process of Fujimaru et al. in the manner suggested in the Action.

New claim 15 is also allowable over the art of record. Claim 15 is directed to a process of producing a water-absorbent resin comprising the step of polymerizing a monomer component including acrylic acid or salt where the acrylic acid or salt include protoanemonin as an impurity or by-product where the process includes the step of distilling the acrylic acid in the presence of a hydrazine compound aldehyde treating agent to purify the acrylic acid and to reduce the protoanemonin content to not more than 10 ppm. For the reasons discussed above, Fujimaru et al. either standing alone or in combination with the secondary references do not disclose or suggest the claimed process.

In view of these amendments and the above comments, reconsideration and allowance are requested.

Respectfully submitted,



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